PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Seung Chan BANG, *et al.*	)	
	)	Before the Examiner:
Serial No.: New Application	)	
Filed: January 24, 2001	)	Group Art Unit:
For: ORTHOGONAL COMPLEX SPREADING METHOD FOR MULTICHANNEL AND APPARATUS THEREOF	)	

* *

PRELIMINARY AMENDMENT

To: Assistant Commissioner for Patents
Washington, D.C. 20231

January 24, 2001

Sir:

Prior to the examination based on the merits, please amend the captioned application as follows:

In the Claims:

Please cancel claims 1-40.

Please add the following claims.

--41. An orthogonal complex spreading method for multiple channels, comprising the steps of:

complex-summing $W_{M,n1}X_{n1}$, which is obtained by multiplying an orthogonal code sequence $W_{M,n1}$ by first data group X_{n1} of a n-th block, and $W_{M,n2}X_{n2}$, which is obtained by multiplying an orthogonal code sequence $W_{M,n2}$ by second data group X_{n2} of a n-th block, M and n being positive integers;

complex-multiplying the complex summed form of $W_{M,n1}X_{n1}+jW_{M,n2}X_{n2}$, by a complex form of $W_{M,n3}+jW_{M,n4}$ and outputting $(W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})\times(W_{M,n3}+jW_{M,n4})$ as an output signal; and

summing in-phase and quadrature phase parts of the output signal outputted from a plurality of blocks as

$(\sum_{n=1}^{K}((W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})\times(W_{M,n3}+jW_{M,,n4})))$, K is a predetermined integer greater than or equal to 1 to generate I channel and Q channel signal.

42. The method of claim 41 wherein a spreading code spreads the summed in-phase and quadrature–phase signals outputted from the summing step.

43. The method of claim 41 wherein said orthogonal code sequence includes a Hadamard code sequence.

44. The method of claim 41 wherein said orthogonal code sequence includes a Walsh code.

45. The method of claim 42 wherein said spreading code is one spreading code.

46. The method of claim 45 wherein said spreading code sequence includes a PN code.

47. The method of claim 45 wherein said spreading code includes a first spreading code for the in-phase signal and a second spreading code for the quadrature-phase signal.

48. The method of claim 47 wherein the first and second spreading codes are PN codes.

49. The method of claim 43 wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,13}=W_0$, $W_{M,14}=W_1$, when M=4.

50. The method of claim 49 wherein $M=8$ and $W_{M,12}=W_4$.

51. The method of claim 43 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$, where p represents a predetermined number in a range from 0 to (M/2)-1, and $W_{M,n3}=W_{2n-2}$, $W_{M,n4}=W_{2n-1}$.

52. The method of claim 43 wherein $W_{M,21}=W_0$, $W_{M,22}=W_4$, $W_{M,23}=W_2$, $W_{M,24}=W_3$ when $M=8$ in case of two channels.

53. The method of claim 52 wherein $W_{M,12}=W_6$, and $W_{M,22}=W_6$.

54. An orthogonal complex spreading apparatus, comprising:

a plurality of complex multiplication blocks, each for complex-multiplexing a complex signal $W_{M,n1}X_{n1}+j\,W_{M,n2}X_{n2}$ by $W_{M,n3}+jW_{M,n4}$ wherein $W_{M,n1}X_{n1}$ is obtained by multiplying an orthogonal code sequence $W_{M,n1}$ by first data group X_{n1} of n-th block and $W_{M,n2}X_{n2}$ is obtained by multiplying orthogonal sequence $W_{M,n2}$ by second data group X_{n2} of the n-th block, wherein M and n are positive integers and $W_{M,n1}$, $W_{M,n2}$, $W_{M,n3}$ and $W_{M,n4}$ are predetermined orthogonal sequences; and

a summing unit for summing in-phase and quadrature phase parts of an output signal from each block of the plurality of the complex multiplication blocks as

$$\left(\sum_{n=1}^{K}((\alpha_{n1}W_{M,n1}X_{n1} + j\alpha_{n2}W_{M,n2}X_{n2}) \times (W_{M,n3} + jW_{M,,n4}))\right),$$ K is a predetermined integer greater than or equal to 1.

55. The apparatus of claim 54 further comprising a spreading unit for multiplying the summed in-phase and quadrature phase signals inputted from the summing unit by spreading code.

56. The apparatus of claim 55 wherein said spreading unit multiplies the in-phase and quadrature phase part by different spreading codes.

57. The apparatus of claim 54 wherein each said complex multiplication block includes:

a first multiplier for multiplying the first data group X_{n1} by the orthogonal code sequence $W_{M,n1}$;

a second multiplier for multiplying the second data group X_{n2} by the orthogonal code sequence $W_{M,n2}$;

third and fourth multipliers for multiplying the output signal $W_{M,n1}X_{n1}$ from the first multiplier and the output signal $W_{M,n2}X_{n2}$ from the second multiplier by orthogonal code sequence $W_{M,n3}$;

fifth and sixth multipliers for multiplying the output signal $W_{M,n1}X_{n1}$ from the first multiplier and the output signal $W_{M,n2}X_{n2}$ from the second multiplier by orthogonal code sequence $W_{M,n4}$;

a first adder for subtracting output signal from the sixth multiplier from output signal (ac) from the third multiplier and outputting an in-phase information; and

a second adder for summing output signal from the fourth multiplier and output signal from the fifth multiplier and outputting quadrature phase information.

58. The method of claim 57 wherein said orthogonal code sequence includes a Hadamard code sequence.

59. The method of claim 57 wherein said orthogonal code sequence includes a Walsh code.

60. A permuted orthogonal complex spreading method for multiple channels allocating at least two input channels to first and second groups, comprising the steps of:

multiplying a predetermined orthogonal code sequence $W_{M,n1}$ by first data group X_{n1};

multiplying orthogonal code sequence $W_{M,n2}$ by second data group X_{n2};

summing output signals $W_{M,n1}X_{n1}$ and $W_{M,n2}X_{n2}$ in the complex form of

$$\sum_{n=1}^{K}(W_{M,n1}X_{n1} + jW_{M,n2}X_{n2});$$ and

complex-multiplying the received output signal

$\sum_{n=1}^{K}(W_{M,n1}X_{n1} + jW_{M,n2}X_{n2})$ by $(W_{M,I}+jPW_{M,Q})$ wherein P is a predetermined sequence, and $W_{M,I}$ and $W_{M,Q}$ are orthogonal code sequences.

61. The method of claim 60 wherein the spreading code is a PN code.

62. The method of claim 60 wherein P represents said predetermined sequence or predetermined spreading code or predetermined integer configured so that two consecutive sequences have identical values.

63. The method of claim 57 wherein said orthogonal code sequence includes a Hadamard code sequence.

64. The method of claim 57 wherein said orthogonal code sequence includes a Walsh code.

65. The method of claim 63 wherein $W_{M,I}=W_0$, $W_{M,Q}=W_{2q+1}$ (where q represents a predetermined number in a range from 0 to (M/2)-1).

66. The method of claim 63 further comprising the steps of:

multiplying the first data group X_{n1} by gain α_{n1}; and

multiplying the second data group X_{n2} by gain α_{n2}.

67. The method of claim 63 wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, when M=4.

68. The method of claim 67 wherein M=8 and $W_{M,12}=W_4$.

69. The method of claim 63 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2q+1}$, wherein q represents a predetermined number in a range from 0 to (M/2)-1 and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

70. The method of claim 60 wherein each group has at least two channels and the receiving step includes the steps of:

summing output signals $W_{M,n1}X_{n1}$ from a first sequence multiplier; and

summing output signals $W_{M,n2}X_{n2}$ from a second sequence multiplier.

71. A permuted orthogonal complex spreading apparatus for multiple channels, allocating at least two input channels to first and second groups, comprising:

a first multiplier block having at least one channel contained in a first group of channels, each for outputting $W_{M,n1}X_{n1}$ which is obtained by multiplying first data group X_{n1} by orthogonal code sequence $W_{M,n1}$, M and n are positive integers;

a second multiplier block having a number of channels having at least one channel contained in a second group of channels, each for outputting $W_{M,n2}X_{n2}$ which is obtained by multiplying a first data group X_{n2} by orthogonal code sequence $W_{M,n2}$;

a complex multiplier for receiving the output signals from the first and the second multiplier blocks in a complex form of

$\sum_{n=1}^{K}(W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})$ and complex-multiplying received output

signal by $W_{M,I}+jPW_{M,Q}$, wherein $W_{M,I}$ and $W_{M,Q}$ are predetermined

orthogonal code sequence permuted and P is a predetermined sequence.

72. The apparatus of claim 71 wherein said orthogonal code sequence includes a Hadamard code sequence.

73. The apparatus of claim 71 wherein said orthogonal code sequence includes a Walsh code.

74. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, when M=8 in case of three input channels.

75. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of three input channels.

76. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of four input channels.

77. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,I}=W_0$, $W_{M,Q}=W_1$ and $W_{M,21}=W_8$ in case of four input channels.

78. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_1$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of five input channels.

79. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,21}=W_2$, $W_{M,31}=W_6$, $W_{M,22}=W_3$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ in case of five channels.

80. The apparatus of claim 71 wherein $W_{M,11}=W_0$, $W_{M,12}=W_4$, $W_{M,31}=W_2$, $W_{M,22}=W_6$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$ and $W_{M,21}=W_8$ in case of five input channels.

81. The apparatus of claim 76 wherein $W_0X_{11}+jW_4X_{12}$, W_2X_{21} and W_6X_{31} are replaced by $\alpha_{11}W_0X_{11}+j\alpha_{12}W_4X_{12}$, $\alpha_{21}W_2X_{21}$ and $\alpha_{31}W_6X_{31}$, and a gain α_{n1} and a gain α_{n2} are the identical gain in order to remove the phase dependency by an interference occurring in a multipath of a self signal and an interference occurring by other users.

82. The apparatus of claim 71 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$.

83. The apparatus of claim 71 wherein the first multiplier block comprises at least a third multiplier for multiplying the first data group X_{n1} by gain α_{n1}, and the second multiplier block comprises at least a fourth multiplier the second data group X_{n2} by gain α_{n2}.

84. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{4/1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/4}$,when M=8 in case of two input channels.

85. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{4/1}$, $W_{M,21}=W_2$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/4}$, when M=8 in case of three input channels.

86. The method of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{2/1}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/2}$,when M=8 in case of two input channels.

87. The apparatus of claim 72 wherein $W_{M,11}=W_0$, $W_{M,12}=W_{2/1}$, $W_{M,21}=W_4$, and $W_{M,I}=W_0$, $W_{M,Q}=W_{1/2}$, when M=8 in case of three input channels.

88. The apparatus of claim 71 wherein each group has at least the two input channels, further comprising:

a first adder for outputting

$$\sum_{n=1}^{K} (W_{M,n1}X_{n1})$$ by summing output signals from the first multiplier block; and

a second adder for outputting

$$\sum_{n=1}^{K} (W_{M,n2}X_{n2})$$ by summing output signals from the second multiplier block.

89. The apparatus of claim 71 further comprising:

a spreading unit for multiplying the signal

$$\sum_{n=1}^{K} (W_{M,n1}X_{n1}+jW_{M,n2}X_{n2})$$ received by the complex multiplier by a spreading code.

90. The apparatus of claim 89 wherein the spreading unit respectively multiplies the in-phase and quadrature-phase parts by different spreading codes.

91. The apparatus of claim 71 wherein $W_{M,n1}$, $W_{M,n2}$, $W_{M,I}$, and $W_{M,Q}$ are orthogonal Hadamard sequences.

92. The apparatus of claim 71 wherein the complex multiplier includes:

fifth and sixth multipliers for multiplying said output signal from the first multiplier block and said output signal from the second sequence multiplier by orthogonal sequence $W_{M,I}$;

seventh and eighth multipliers for multiplying said output signal from the first multiplier block and output signal $\alpha_{n2}W_{M,n2}X_{n2}$ from the second multiplier block by orthogonal sequence $W_{M,Q}$;

a third adder for subtracting output signal from the eighth multiplier from output signal from the fifth multiplier to output an in-phase information; and

a second adder for summing output signal from the sixth multiplier and output signal from the seventh multiplier to output quadrature-phase information.

93. A permuted orthogonal complex spreading apparatus for multiple channels, allocating at least two input channels into first and second groups, comprising:

first and second multiplier blocks for respectively multiplying first and second data group X_{n1}, and X_{n2} with a set of predetermined orthogonal sequences $W_{M,n1}$, and $W_{M,n2}$ to output $W_{M,n1} X_{n1}$ and $W_{M,n2} X_{n2}$;

a complex multiplier for receiving the output signals $W_{M,n1} X_{n1}$ and $W_{M,n2} X_{n2}$ from the first and the second multiplier blocks in the complex form of

$$\sum_{n=1}^{K}(W_{M,n1}X_{n1} + jW_{M,n2}X_{n2})$$

and multiplying a received signal

$$\sum_{n=1}^{K}(W_{M,n1}X_{n1} + jW_{M,n2}X_{n2})$$

by a predetermined sequence $(W_{M,I} + jPW_{M,Q}) \times SC$, wherein $W_{M,I}$, $W_{M,Q}$ are predetermined orthogonal sequences, P is a predetermined sequence and SC is a spreading sequence.

94. The apparatus of claim 93 wherein each group has at least two input channels, further comprising:

a first adder for outputting

$$\sum_{n=1}^{K} (W_{M,n1}X_{n1})$$ by summing output signals from the first sequence multiplier; and

a second adder for outputting

$$\sum_{n=1}^{K} (W_{M,n2}X_{n2})$$ by summing output signals from the second sequence multiplier.

95. The apparatus of claim 93 wherein the first sequence multiplier comprises at least one first gain multiplier for multiplying the data X_{n1} of each channel of the first group by gain α_{n1}, and the second sequence multiplier comprises at least one second gain multiplier for multiplying the data X_{n2} of each channel of the second group by gain α_{n2}.

96. The apparatus of claim 93 wherein $W_{M,n1}=W_0$, $W_{M,n2}=W_{2p}$, and $W_{M,I}=W_0$, $W_{M,Q}=W_1$, where p represents a predetermined integer in a range from 0 to (M/2)-1.

97. The apparatus of claim 93 wherein $W_{M,n1}$, $W_{M,n2}$, $W_{M,I}$, and $W_{M,Q}$ are orthogonal Hadamard sequences.--

It is respectfully submitted that the captioned application is now in condition for examination on its merits.

Respectfully submitted,

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